

Original scientific paper

**ACCEPTANCE OF CLOUD COMPUTING IN
AN AIRLINE COMPANY BASED ON ROGER'S DIFFUSION
OF INNOVATION THEORY**

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Abstract. *As using cloud computing develops, one of the problems that managers face at the organization level is that the personnel cannot work with these systems, users do not accept these new systems and the problem of accepting these technologies, effective factors in accepting them and the existing barriers in accepting them by users are very important. In many organizations wherein cloud computing has been launched, a time period is required to accept this new system by their personnel. If this time period is less and the personnel can work with these systems earlier, the productivity increases in the organization. The present paper aims the analysis of effective factors on acceptance of cloud computing by personnel working in Birjand International Airport in South Khorasan County (Iran) based on Roger's diffusion of innovation theory. Examination of effective factors on acceptance of cloud computing in an organization can pave the way for improving its implementation and performance. This research has been done by descriptive survey method and its community includes personnel working in different official and informatics departments of Birjand International Airport. The data gathering instrument was questionnaire and for determining questionnaire validity opinions of masters and for determining consistency Cronbach's alpha has been used. For data analysis descriptive and inferential statistics have been used. The results of present paper indicated that there is meaningful and positive relationship between acceptance features of cloud computing and perception elements of testability, comparative advantage, visibility, complexity, and compatibility of cloud computing with its acceptance rate and there is meaningful and negative relationship between features of perception of not needing cloud computing and its acceptance rate. But there was no meaningful relationship between perception of cloud computing test opportunity and its acceptance rate. As one of the modern ways of providing electronic service has been cloud computing in recent years and it has many benefits for air transportation systems, this paper presents a model for analysis of effective factors in*

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acceptance of cloud computing among personnel of an airline company (airport) and it can be used for examining cloud acceptance in other air companies.

Key words: *Cloud Computing, IT, Computing Services, Roger's Diffusion of Innovation Theory, Adoption of Cloud Computing*

1. INTRODUCTION

Nowadays, with the development of IT in many organizations and institutes, has resulted in a number of fundamental and massive changes that have taken place in comparison with the past, these changes have forced organizations to maintain presence in the field of competition in order to survive in the current intense competitive market, leaving no other option for the organizations, but to transform and use the latest available technological achievements in order to reach the highest levels of capability for either themselves or their employees or perhaps even possibly both [1]. Therefore, it can be claimed that the information technology in other words has overtaken other evolving technologies and is considered essential and a basic need for entire organizations and individuals in many different industries all over the world [2]. Furthermore, cloud computing is considered to be one of the latest forms of providing data services which has managed to attract the attention of many organizations and data collecting institutions lately, in addition, this particular technology is now considered to be the latest generation in the evolution of the internet that can possibly demonstrate the future of application engineering and design [3]. As defined by the National Institute of Standards & Technology (NIST), cloud computing is basically a model type used for providing simple network access in accordance with the users need, for a shared repository derived from computing resources configurations. In addition, networks, servers, applications and services are all great examples of such services which can be available and provided quickly with minimum management efforts as well as minimum interactions coming from service providers [4]. Additionally, from a (NIST) perspective, the five features of cloud computing include on-demand services, broad network access, resource pooling and rapid elasticity as well as service measurements. However, cloud computing, which is the next generation of network and grid computing, can provide the possibility of using information technology, that has been initially proposed as a service provided through the networks. It is important to know that this technology represents a set of services in the forms of various packages and has an application program interface (API) that can be used in the network which may include both storage and computing services [5]. The term cloud refers to the data center of a hardware as well as its software provider [6]. Moreover, cloud computing is built on the foundation that instead of organizations and institutes creating their own hardware & software for storage use and process of data, they can launch cloud computing, and use its many featured services, then pay based on the overall usage, instead of purchasing various products through the network. In this regard, we can refer to companies and institutes providing public services to the industries such as water, electricity, telephone lines and internet, which can possibly eliminate the need for individual and organizations to purchase infrastructure related to these particular industries, instead, they can use cloud computing services and pay the related costs based on the precise amount of their usage either individually or organization-wise. Furthermore, in the field of cloud computing, large firms and institutions that have the potential as well as

capital can very well create their own necessary infrastructure, such as the Cloud Computing Research Center of Amirkabir University of Technology & the Free Cloud Computing Society of Iran [7].

According to the theory of Roger and Shoemaker, 50% of people in society are resistant to innovation who are known as resistant and slow groups, and the other 50% are people who are more receptive to innovation. This division is shown by Shoemaker as a normal distribution [8]. Venkatesh et al. [9] introduced the conceptual basis of most technology acceptance models which is depended on the relationship between individual reactions to the "intention to use" and "actual use" of technology as shown in Figure 1.

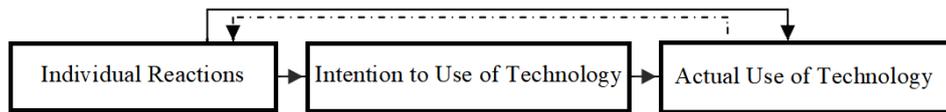


Fig. 1 The Conceptual Basis of Technology Acceptance Models (Venkatesh et al.2003)

Organizational change more concerns employees with long experience rather than novices. Experienced employees are usually older and have lower media literacy [10]. Indeed, these employees have been accustomed to perform things in their usual way for years. Thus, the manager must expect resistance if the change involves forcing employees to modify their performance way. The change, itself, is not a problem for employees, however, the possibility that these employees who already know what to do in any situation will no longer be considered an "expert" is an issue. Being an expert, for many people, is very important in terms of self-esteem. The use of cloud computing technology means accepting changes in system performance, therefore, some human resources of the organization resist it. If this acceptance is inconsistent with their ability and job position, this resistance will be increased. Acceptance of technology as an individual-voluntary behavior has been explained by various models. In this regard, the Theory of Reasoned Action (TRA) [11], Fishbein & Ajzen (1975) and Theory of Planned Behavior (TPB), Ajzen (1991) [12], Technology Acceptance Model (TAM), Davis (1989) [13], Technology, Organization and Environment (TOE) framework Tornatzky & Fleischer (1990) [14], Diffusion of Innovations (DOI) Rogers (2010) [15] and the Unified Theory of Acceptance and Use of Technology (UTAUT), Venkatesh et al. (2003) [9] can be listed. Some acceptance theories, such as the technology acceptance model and the theory of planned behavior, are more appropriate for assessing the acceptance of final users (individuals) [16]. In some acceptance theories, such as technology, the environmental organization relies more on the organizational attitude. Since environmental influences are effective on technology acceptance, the importance of this dimension in technology acceptance is another strength of this theory. This theory provides a framework including three variables of technology and organization and environment to study the acceptance of new technologies in organizations [17]. Cloud computing acceptance, especially among organizations, is enhanced through public access to services, which offers several benefits such as increased flexibility and agility [18]. Therefore, promoting cloud computing acceptance is an important issue for policymakers due to its many benefits [19]. This study [20] assessed the model of acceptance of cloud computing technology, deployment, presenting the optimal method of its use and implementation. The findings showed that cloud computing and the use of

the model (cloud computing: evaluation of cloud computing for acceptance and use) can provide an appropriate path for efficient cloud implementation. Roger's theory is more concerned with the processes of diffusion innovation and its acceptance in a systematic and planned method. This theory assesses the social process of innovation and how it is achieved and extended to an entire social system. Rogers' theory of diffusion innovation has been applied in this research since our case study was the personnel of an international airport in the east of Iran and the fact that accepting this innovation takes time and people do not accept it immediately. This theory is also used in the commercialization of research results, innovation resulting from technological opportunities, and the marketing of new products. The innovation process can be adapted to the Rogers model to explain the behavioral and social characteristics at different stages of the innovation process within the organization [21].

Furthermore, based on the many benefits and features of using cloud computing services, which are gradually becoming more and more popular to the organizations as well as the general population, we come to conclusion that this particular technology can possibly play a major role in the aviation & airport-related industries, in order to properly assist airlines in providing the best possible services to the passengers, in addition to helping the organization as a whole, achieve success and greatness. Besides, the low degree of knowledge about the new cloud services features, among the airport staff, can possibly cause uncertainty and curiosity within the members of the staff, and as a result may very well motivate them, so they can learn in greater details about this particular new technology. Moreover, the higher the degree of familiarity and comprehension of staff with the cloud computing and its various features, can very well lead to a much better and more efficient service use. In addition, identifying the various factors affecting the overall acceptance and adoption of cloud computing, as well as determining its impacts on increasing the quality of airport services and features is of great importance, in order to create and plan the perfect policies for organizational objectives, because, the introduction and widespread use of cloud technology can possibly lead to huge quantitative as well as qualitative changes in the services and features of airports and aviation systems overall. Although, the main issue in using such brand new technologies is the analyze and measure of the precise degree of staff willingness for using these newly available tools and technologies [22]. Additionally, before implementing new technologies in any organizations, both managers and employees of that particular organization must have a complete and clear understanding of the upcoming technology, as well as its various advantages and possible uses in their executed activities, in addition to the close observation & evaluation of the various available functions and efficiencies that these innovative technologies may provide in organizational process.

Birjand International Airport has both, IATA code: (XBJ) as well as ICAO code: (OIMB), and is usually used for commercial flights (birjand.airport.ir). Furthermore, due to the political and strategic position of Birjand, being located in the east of Iran, in addition to having (331 km long) of common border with the neighbor country, Afghanistan, as well as being the third airport built in Iran in the year (1933), after the construction of Qala-e-Marghi airport in (Tehran) and Bushehr airport. Additionally, Birjand is located at 59° and 13 minutes longitude, 32° and 53 minutes of latitude, at an altitude of 1,470 meters above the sea level, as well as being the capital city of Southern Khorasan province. Moreover, due to the strategic and sensitive location of this particular city, a considering amount of attention had been paid to the air navigation system, specifically on the Birjand airport,

and therefore, having new and more efficient systems, such as the use of cloud computing services in the Birjand airport can possibly be of great significance [23] [24] [25].

In addition to the cloud computing, the current study uses Roger's Diffusion of Innovation theory, which will be discussed in greater details in the following chapter. According to Roger in the year 1995, the definition of innovation is basically any new or original idea, object, practice or it can even include something that only appears new. However, despite the title given to the word innovation, it does not necessarily mean that it has to be an extremely new and innovative idea which was never seen before. In fact, it can be called innovation if the new upcoming idea, method or object is perceived as new by those particular people who are willing to accept and use it. Therefore, when it comes to publishing a brand-new idea, it is much more important for the idea to appear new to the targeted market, rather than having a high degree of actual new features and characteristics [26]. Additionally, according to Roger (1995), [26], these are the four innovation dissemination elements: -1- Innovation that is accepted, -2- by the members of the society, -3- through specific communication networks, -4- over a period of time [27].

This research proposes a model for analysis of effective factors in acceptance of cloud computing by personnel of an airline company (airport); the findings of this paper can be a guideline for efficient applying of cloud in air transportation systems and it can also contribute examination of cloud acceptance in other air organizations. At the Birjand International Airport VAST Satellite System and Automatic Terminal Information System (ATIS) is used. Also, in this airport ICT infrastructure is used including datacenter, active and passive network infrastructure, storing and processing infrastructure, weak current infrastructures. In this airport navigation systems of NDB, DVOR, VOR, DME are used. Communication systems like switching tower, access (controller), recorders, fixed and moving senders-receivers, FM and AM bands, sending system of meteorology information, using Automatic Dependent Surveillance system as ADS-B and ADS-C for increasing radar coverage. Also in this airport, RCAG flight control system, electronic flight planning (EFPL) and GPS system, microwave, closed circuit television (CCTV) and nationally integral flight information display system (FIDS) and PAPI and SALS systems are used. Also, this airport is planning to implement intelligent transportation system (ITS), The Aeronautical Telecommunication Network (ATN), control center and A-SMGCS system and in addition, Birjand International Airport is planning to use WTMD auxiliary inspection system, intelligent Gate Way systems, purchasing new equipment with X-ray modern technology using IOT. Also in this airport, the remote tower scheme has been proposed and it is studied by an Iranian company though installation, launching and maintaining ILS equipment is costly for the airport. Its high ranking authorities are planning to use performance based navigation (PBN), biometric identity identification is among other research plans in Birjand International Airport and it hasn't been operated yet.

In this research, the characteristics of innovation that are effective in its acceptance rate are discussed from Roger's point of view in the second section. The research literature review and previous work concerning cloud computing are discussed in the third section. Research methodology is stated in the fourth section. The findings and hypotheses of the research are defined in the fifth section. The regression model of the determinants of the cloud computing acceptance rate is stated in the sixth section. The conclusion and comparison of this research with similar works are discussed in the final section.

2. VARIOUS CHARACTERISTICS & FEATURES OF INNOVATION ACCEPTANCE

Roger indicated several technological characteristics to be extremely effective in the adoption rate, which include: a) Comparative Advantage, b) Compatibility, c) Complexity, d) Testability as well as e) Observability of the Results [28] [29].

Comparative Advantage: It refers to the precise degree of the comprehension of individuals on whether the new innovation is more efficient and generally better than the current technology in order to successfully replace it. Additionally, the degree of comparative advantage is measured by economic factors, however often other factors such as social credibility, convenience and overall satisfaction with technology acceptance can also play a major role in these measurements. Besides, the objectivity of the innovation and its many benefits are not nearly as important as understanding the precise degree of the advantages of innovation via consumers. Moreover, the better the innovator perceives the benefits of the created innovation or technology, the quicker the process of their adoption and acceptance will be.

Compatibility: It specifically refers to the extent of individual perception of innovation in harmony with current existing values, past experiences as well as meeting the requirements and needs of the recipient. Besides, those ideas and innovations that are considered to be compatible with prevailing social values seem to be quicker accepted rather than the ones that are not compatible with the social values. Generally, accepting an incompatible technology often requires the initial acceptance of an entirely new value system.

Complexity: It indicates the degree to which an individual fathoms the difficulties of learning and applying innovation and new technologies. Furthermore, for most regular members of the society, some new technologies are simpler to comprehend and apply than others, while other technologies may not be so, and hereby they will gradually be accepted by the targeted market in a longer period of time. In general, brand-new ideas that do not require specific learning and investment are often accepted much sooner than those technologies that need the acquirement of new skills & knowledge.

Testability: It refers specifically to the review and examination of technologies available at a limited level. Additionally, we also learn that technologies that can possibly be tested with limited facilities and resources have a higher chance of being accepted by the society quicker rather than those that cannot be examined at all. Additionally, innovations that have been previously tested on a smaller scale seem to be significantly less risky to use.

Observability: It refers to the extent to which the results of technologies are visible and clear to the society and others. Besides, the clearer the results of the innovation to the people, the more likely it is to be sooner accepted by the general population and the rest [28] [29].

Roger, in the year (1995) [26] makes the argument that those innovations and technologies which possess comparative advantage, greater compatibility, higher degree of objectivity and less complexity are much easier and faster to adopt by their recipients in comparison with other available innovations.

Furthermore, due to the vast number of capabilities cloud computing can offer, many institutions and organizations (both public & private) are gradually considering making use of such abilities which can possibly process the most amount of data and information technology in the shortest possible time as well as the lowest cost. Additionally, experts suggested using and setting up cloud computing facilities for aviation and airport-related systems in order for them to meet every need and requirements of the passengers even at the busiest times. Meanwhile, most air terminals and airports can meet their specific

requirements using one of the predominant forms of cloud computing (which involves public, private, collective and hybrid cloud services). Moreover, the use of cloud computing technology in both private and public institutions and organizations in Iran is lower than in the other parts of the globe. Besides that, it can be claimed that only a limited number of institutions are even aware of the very existence of this new technology and the many benefits and its uses. In addition, one of the main reasons causing this is the lack of managers and officials' overall knowledge about the many capabilities of this particular technology. As a result, this lack of knowledge and familiarity can possibly create a huge gap between the organizations and the available benefits of the cloud computing and may very well cause the organizations to never take advantage from such technologies which could potentially lead to huge positive impacts.

The discoveries made by the current study conducted on the staff members of Birjand International Airport can potentially be extremely effective by providing the necessary information about the many available features of cloud computing and as a result can potentially lay the necessary foundations for accepting the cloud computing technology by the entire staff of the airport. Additionally, the present conducted study attempts to examine the many factors affecting the acceptance rate of the cloud computing by the working personnel at Birjand International Airport, in order to determine whether there is a relationship between the characteristics and features of the cloud computing services and its adoption rate through the people or not.

3. RESEARCH BACKGROUND

Prior to the current study, there has never been a proper research conducted, specifically on the acceptance rate of cloud computing usage in the airports and aviation industry, based on the Roger's diffusion of innovation theory. Therefore, based on the theory, the main focus of the current research background segment lies within data science and science-related fields of study.

Behrend et al. (2011) conducted a study on the acceptance and use rate of cloud computing amongst approximately 750 local college students who all took part in the computing skill-based courses. Furthermore, in the process of this research, which was conducted through an online questionnaire, factors such as the access to software, easier transportation, individual creativity, technological concerns, teacher supports and reliability were all individually examined and known as determining factors affecting the overall usefulness comprehension, user-friendliness as well as the actual and future potential uses. Additionally, the analysis results indicate that the two factors of usefulness comprehension as well as user-friendliness both seem to have a huge positive effect on the decision makings that concern the use of cloud computing amongst the students, on the other hand, despite the various negative impact of factors such as technology concerns, access to software, easier communications and transportations, the factor of easy comprehension still remains more significant than the other utility comprehension factors, and as a result, utilities comprehension do not affect the use of cloud computing amongst students in great extent [30]. In another conducted research by Opitz et al. (2012), they examined the acceptance rate of cloud computing using data analysis obtained from 100 IT managers amongst the leading companies of Germany in the stock market. Moreover, in this study, which was conducted through a questionnaire, they have come to conclusion that there is a significant relationship in the use of cloud computing services between the factors of usefulness and

the according behavior of the managers, additionally, conducted study also shows that the easy use factor for managers who use cloud services has significantly less effect in comparison to the manager behavioral factors [31]. Furthermore, Alharbi in (2012) examined the adoption rate of cloud computing in Saudi Arabia using factors including age, gender, field of work, degree of education and nationality. Additionally, the results obtained from this study which was conducted through an online questionnaire specifically on 171 employees of IT organizations in the Saudi Arabia using the linear regression, indicates that there is a constant significant relationship between the factors of usefulness comprehension as well as the easy use of the cloud services and the manager behavioral factors. On the other hand, there is also a significant relationship between the perception of easy use and usefulness factors, and the total usefulness comprehension as well as the managers behavioral responsive factors which can ultimately affect the decision makings on whether to use the cloud computing services or not [32].

Akbari, Sohrabi & Zanjani in (2012) in another study, examined the status and acceptance rate of search engines as well as meta search engines among the users of the University of Isfahan based on Roger's diffusion of innovation theory. Additionally, the main purpose of this research was to investigate the acceptance rate and identify the various capabilities and effective tools used in accepting search & Meta search engines by the users of the University of Isfahan. The obtained results show that the average acceptance rate of search engines and meta search engines by the users of the University of Isfahan was not statistically significant in terms of gender, particular grade or even faculties, and the only significance discovery found in terms of accepting specialized search engines was only related to gender alone. On the other hand, the results showed that users friends however, did play a major role on how public search engines and subject directories were accepted, as well as professors who can potentially be extremely effective on how specialized search engines and meta search engines are accepted by the entire community. Furthermore, they came to the conclusion that the best possible place for search engines and meta search engines to be used is applying them at the universities. Moreover, there was also a comparison conducted, between the use of simple or advanced Google Search pages which indicated that there is a greater tendency among users than a simple search page, in addition, this also absolutely confirmed Roger's theory in every way [33]. Luo (2012) [34] in this research examined precisely how reference librarians can potentially use the cloud computing services and technology. Additionally, the overall objective of the current study is to use software-oriented as well as software as a service (SAAS) tools in order to support and facilitate their work. Furthermore, the obtained results of the study indicated that the librarians may use such tools for a variety of purposes, including facilitating, internal communication, collaborative work, data support as well as literacy practices and trainings. Heidari, Alizadeh & Hamdipour (2013) in another study, investigated the various factors affecting the adoption rate of electronic data resources conducted using the faculty members of Iranian Data Science Departments based on Roger's diffusion of innovation theory. Furthermore, it must be added that the conducted research method used was descriptive-survey, which could be completed through a set of electronic questionnaires. Additionally, the findings of exploratory factor analysis identified the most significant features of electronic data resources which include: comparative advantages, testability, compatibility, observability as well as available testing opportunities. Further discoveries show that the above features have a meaningful relationship with the speed of adoption of electronic data resources such as clouds and can potentially be very effective in the adoption rate. Moreover, the multivariate results show that the characteristics of observability, test opportunity as well

as age are considered to be important predictors in the acceptance of electronic data resources which statistically takes 27% of the dependent variable variance. Generally, the discoveries seem to confirm the Roger's diffusion of innovation theory (2003) in understanding the various characteristics of electronic data resources using the working members of the Iranian Department of Data Science [35].

Fung (2013) in this study they used the TAM model types and Port Five Forces analysis in order to estimate the decision being made on whether to apply the cloud computing technology in IT outsourced services or not. Furthermore, based on this quantitative interference research that has been conducted through an online questionnaire, multi regressions and path analysis via (PLS) software, however, the only considered factors being investigated here are the comprehension of the many features, user-friendliness and the overall response towards the acceptance of cloud computing, specifically the (TAM) model type. According to the obtained results, the perception factor in the overall acceptance of cloud computing can positively and in a major way estimate the perception factor of its usefulness. Additionally, we also learn that both the factors of usefulness comprehension of cloud computing features as well as the degree of user-friendliness can very well significantly predict the decision-making factor of accepting the cloud services [36]. Sun et al. (2014) in this particular conducted research, they mostly focused on the cloud service providers perspective which were categorized into five groups including: a) the use of decision-making methods, b) the use of data display models, c) the use of cloud service characteristics parameters, d) the content and finally e) objectives [37].

Yuvaraj (2014) in this study, a survey was conducted on 209 librarians of the Central Library of University of India in order to determine the precise degree of acceptance of cloud computing services and apps amongst these individuals. Additionally, using this survey and data collection method which was conducted continuously for eleven months using postal questionnaire, Yuvaraj emphasizes the effects of four possible factors on using cloud computing services & applications including: usefulness comprehension of the cloud, understanding the easy use of cloud, as well as decision-making and the behavior towards the use of cloud computing. In addition, according to the results of the research, there was no significant relationship amongst the above factors in using cloud computing applications. However, there was a significant relationship found between the usefulness comprehension of the cloud and the behaviors towards its use [38]. This particular study examines the cloud migrations that have occurred during the years (2009-2014) as well as introducing a set of factors affecting the adoption rate of cloud computing services in the form of a conceptual model, in addition, these various key factors include the feasibility study of cloud migration, analysis of development of migration plan requirements, cost-reduction, low effort in order to maintain resource, efficient use of resources as well as the unlimited scalability of the resources [39].

Mangai, Ganesan & Kumar (2014) in another conducted research, they examined the current and possible future of using cloud computing tech in library services. Furthermore, in this study, they analyzed the origin, the various types, the impact on libraries as well as the potential benefits and drawbacks of cloud computing in general. In the end, they concluded that (Information and Communication Technology) (ICT) have forced the libraries to change the process and performance of information, besides, with the rapid advancement of technology, automated, digital, and other advanced libraries are consequently created. Additionally, the research team back then sincerely believed that soon users will be able to access their information from anywhere in the world through this particular technology (cloud computing), which may very well save a considerable amount

of money as well as time and resources all at the same time [40]. Scholtz (2016) examined the technical and environmental factors that could potentially affect the adoption rate of cloud computing specifically in the public departments of South Africa. Additionally, in this particular study, there were 51 experts from 40 different public-oriented organizations of South Africa were surveyed using the Delphi method as well as a questionnaire. Furthermore, the findings indicated that most participants were very concerned about their individual privacy, which ranked number one amongst all factors. In addition, environmental factors such as constant learning pressure, being resistant to change, lack of sense of security and etc. are all considered other major factors that must be dealt with in order to properly and legally implement cloud computing services as a provider to such organizations based on their specific requirements [41]. Valmohammadi & Mazaheri (2017) in this conducted research, based on the technology acceptance model as well as the use of the Davis model, they managed to thoroughly described the factors that can potentially influence the final decision on the use of cloud computing amongst the employees working at the National Radio & Television Organization of Iran, in which case, the utility comprehension and perception was identified as the most significant factor that influenced the decision on whether to use the cloud computing services or not [42].

Yuvaraj, Mayank (2016) studied factors affecting the acceptance and targeted use of cloud computing in the libraries of medical universities in India using the Delphi 3D method. This study was conducted by a group of 32 experts with experience in cloud computing in the field of libraries. 60 different factors were identified of which 42 of them had a direct impact on the level of acceptance and targeted use of cloud computing technologies in the mentioned libraries [43]. Heydari Dahouei et al. (2017) through this research, they managed to provide somewhat a framework in order to select the appropriate system for implementing cloud computing. Additionally, a case study was conducted on the Faculty of Modern Sciences and Technologies, at the University of Tehran. In conclusion, experts determined that the criteria of accessibility, system reliability as well as stability were all considered to be the top most important determining factors [44]. Sabi et al. (2018) conducted another research on acceptance rate of cloud computing in the southern regions of Africa, in which they examined and analyzed building a background model based on the factors that could potentially affect the actual acceptance rate. Additionally, the methods they used included a mixture of either (DOI, Diffusion of Innovation theory) or (TAM, which stands for Technology Acceptance Method model). Furthermore, the obtained results indicated that socio-cultural factors as well as displaying results, usefulness and data security were all found amongst the most significant factors in order to appropriately accept cloud computing in universities [45]. Changchit, Chuleeporn and Chuchuen (2018) in another study, they examined the factors that affect the adoption rate of cloud computing. Additionally, they used the technology acceptance model and identified the various factors that could potentially influence the acceptance rate of cloud computing and these factors including usefulness comprehension, easy use, security and the cost of using the cloud computing provided services [46].

Elzamly et al. (2019) [47] proposed a model for cloud computing acceptance in e-banking management systems. In their proposed model, there are four steps to successfully accept the cloud computing model for managing an electronic banking system. The proposed model includes 4 stages which are divided into Technological factors, Organizational factors, Environmental factors, and Operational factors for the acceptance of the cloud computing model. In e-banking systems, the successful adoption of the cloud computing model improves the probability of the success of cloud e-banking in banking organizations. Alidoust et al. [48]

(2020) studied effective factors in the cloud computing adoption of the employees of physical education faculties in Tehran, Iran. In this study, 12 factors affecting the cloud computing adoption were identified and examined, among which 11 factors were considered as a positive effect. The component of complexity has negatively affected the cloud computing adoption intention. Also, technology readiness had the highest impact on cloud computing adoption. The growth of technology readiness among physical education faculties, data security and reducing complexity were identified as the most important factors on cloud computing adoption which can effectively facilitate cloud computing adoption. Albelaihi, Khan (2020) [49] examined the advantages and barriers to the cloud computing adoption in small and medium enterprises in Saudi Arabia. In their research, they interviewed managers of the information and communication technology industry. The questionnaire completed via telephone inquiring managers of the enterprises in different geographical parts of Saudi Arabia. After evaluating the questionnaires, a significant relationship was derived between the use of cloud computing and the increasing quality of services as well as the performance of small and medium companies. They concluded that the level of knowledge of managers in these enterprises is lower than the global average. They also found that the biggest challenge in Saudi Arabia is privacy and security regarding cloud computing service providers and users, which the culture of Saudi Arabia has played a role in preventing the cloud computing adoption. In another study by D. H. Tesema (2020) [50] the challenges and the importance of cloud computing adoption were examined in terms of security, privacy and availability in a commercial bank in Ethiopia. A descriptive method was used to study and analyze the role of cloud computing in commercial banks. Also, the role of cloud computing was analyzed as a powerful tool for savings and cost-effectiveness on large commercial banks considering the mentioned bank as a case study. The results of this study display the main effective factors such as cost efficiency, security and compliance, reliability and also the ability to cooperate in cloud computing adoption in Commercial Bank of Ethiopia (CBE). Omar Ali et al. (2021) [51] assessed the complexity of cloud computing adoption in local governments in Australia. In this research, they proposed a hybrid evaluation model for the cloud computing adoption in the information systems. To evaluate the proposed model, 21 IT managers from local governments were interviewed in the first phase, and then in the second phase, 480 IT employees from 47 local governments responded to an online survey. After evaluating the results, they concluded that the complexity of an organization, the structural complexity of technology, the dynamic complexity of an organization and the dynamic complexity of should be considered in the use of cloud computing and without them, the results will not be satisfactory. The importance of cloud computing acceptance by personnel and the extensive research before its implementation have been considered, thus, this research is conducted to address the importance of cloud systems in aviation, especially in the east of Iran.

4. RESEARCH METHODOLOGY

This conducted research has been completed, using descriptive survey method. Additionally, the selected statistical population for this particular research included all the current personnel who work at the Birjand International Airport which is located in the Southern parts of Khorasan province (Iran). Furthermore, we must add that the used method in this particular case was census method, and not the usual sampling method at all due to the limited number of people, which meant that all the employed personnel

were included. In total, 67 sets of questionnaires were issued amongst the staff from which 57 were returned and analyzed, in addition, these questionnaires were the tools use for data collection in this study. Besides, it is important to know that these sets of questionnaires and dissertations were based on both Roger's Diffusion of Innovation theory as well as other similar researches that have been conducted previously, [27], [35] & [52]. Moreover, the questions of each section of the questionnaire are created, according to the infrastructure and factors that make up Roger's Diffusion of Innovation theory as well as using the various particular features and functions of the technologies under study. Additionally, a total of 30 question along with 6 available options were designed in the form of Likert Scale beginning from (1 = strongly disagree to 6 = strongly agree), in order to accurately measure the overall comprehension of cloud computing available features, in addition, the questionnaire must first be available to professors, experts, sociologists, computer, the management as well as a number of airport staff in order to determine the actual validity of the used tool, and finally after clearing all the discovered errors and mistakes amongst the questions, then the questionnaires are distributed. Later, in order to assess the reliability, the questionnaire was calculated using Cronbach's alpha coefficient, which resulted in 92.2%, besides, also being tested through retest method which was conducted on only a group of personnel who at that time worked at the Birjand International Airport. At the end, SPSS and Excel software are both used in order to thoroughly analyze the obtained results of the questionnaires descriptive statistics and on the other hand, for inferential statistics, were used.

Many organizations are nowadays using their private cloud model that they have set up for their organization. In this study, the cloud computing services used by administration and technology employees of airport were studied. Since the clouds used are private or associate cloud models that are managed by upstream management organizations, they do not have the challenge of confidentiality and the diffusion of sensitive data. Programs have been implemented to transition to the cloud computing model in aviation systems such as flight planning, ticket reservation and sales systems, electronic control of goods, air traffic and navigation control, customs services, accounting and security services in Birjand International Airport (systems that implementation is not possible). Most of the questions in the questionnaire were about the use of software as a service (SAAS). And this cloud computing service is more used and important in the airport business.

5. RESEARCH FINDINGS

A total of 57 individuals were a part of the research, who included 5 females (8.8%) and the rest were all male participants (91.2%). Additionally, the educational degree of most of the participants were bachelor's degree or lower (68.4%), besides, the average age and past service history of the participants being 36.79 ± 4.17 and 12.96 ± 4.43 (Table 1).

Table 1 Demographic Characteristic of the Participants

Variables		Abundance	Percentage
Gender	Female	5	8.8
	Men	52	91.2
Educational Degree	Bachelor's degree or lower	39	68.4
	Master's degree or higher	18	31.6
Age	Mean \pm SD		36.79 ± 4.17
Years of Service	Mean \pm SD		12.96 ± 4.43

Furthermore, Descriptive Analysis of research variables is presented in the following page (Table 2). Additionally, the average score of cloud computing adoption characteristics in total were 120.65 ± 9.99 , on the other hand, the adoption rate was discovered to be 66.09 ± 9.60 , in addition, if the coefficient of elasticity and scalability of the research variables are within the range of $[-2,2]$, then it can be concluded that these particular variables are normally being distributed.

Table2 Descriptive Analysis of Research Variables

Variables	Mean	Standard Deviation	Median	Mode	Variance	Minimum Score	Maximum Score	Skewness	Kurtosis
Testability Comprehension	23.95	3.37	24	21	11.34	17	30	0.39	-0.56
Comparative Advantages Comprehension	42.14	4.05	42	40	16.41	36	51	0.30	-0.91
Understanding the Visibility of Results (Observability)	12.68	1.77	12	12	3.15	10	16	0.24	-1.03
Examination Opportunities Comprehension	7.26	1.48	7	7	2.20	5	11	0.58	0.40
Complexities Comprehension	16.93	2.29	16	20	5.25	13	22	0.43	-1.02
Compatibility Comprehension	8.49	1.28	8	8	1.65	5	10	-0.69	0.38
Understanding the occasional lack of need for cloud computing	9.19	1.91	9	9	3.66	4	12	-0.70	0.65
General Acceptance Features of Cloud Computing	120.65	9.99	116	113	99.95	108	138	0.44	-1.53
Adoption Rate	66.09	9.60	64	55	92.08	53	84	0.55	-0.97

Hypothesis (1): There is a significant relationship between compatibility comprehension of cloud computing and its adoption rate.

The obtained results of Pearson correlation coefficient shown in table (3) indicates that there is a positive relationship between understanding the characteristics of cloud computing testability and the adoption rate ($p < 0.001$ and $r = 0.63$). In other words, the more people who test the new technologies and innovations, the more the adoption rate rises.

Hypothesis (2): There is a significant relationship between the comprehension of comparative advantage of cloud computing and its adoption rate.

The results of Pearson correlation coefficient in table (3) indicates that there is a significant relationship between the comparative nature of cloud computing and its adoption rate ($p < 0.001$ and $r = 0.69$). In other words, the ones who understand comparative advantages more also seem to have a higher and better adoption rate.

Hypothesis (3): There is a relationship between understanding the visibility of cloud computing results and its adoption rate.

In addition, the obtained results of Pearson correlation coefficient in table (3) show that there is a significant relationship between the observability of the results of cloud computing and the adoption rate ($p < 0.001$ and $r = 0.55$). Meaning that people who have higher degree of comprehension on the observability of the results tend to also have higher adoption rate.

Hypothesis (4): There is a significant relationship between the examination opportunities comprehension of cloud computing and the adoption rate.

The obtained results of Pearson correlation coefficient in table (3) indicated that there is a meaningful relationship between fully understanding the possible examination opportunities and the general adoption rate ($p = 0.17$ and $r = 0.18$).

Hypothesis (5): There is also a relationship between the complexities comprehension of cloud computing and the adoption rate.

The obtained results of Pearson correlation coefficient in table (3) show a positive relationship between the comprehension of complexities in cloud computing and its adoption rate ($p < 0.001$ and $r = 0.79$). In other words, those who tend to understand these complexities more and thoroughly, also tend to have a higher adoption rate in general.

Hypothesis (6): There is a significant relationship found between the compatibilities comprehension of cloud computing and the adoption rate.

The obtained results of Pearson correlation coefficient in table (3) show that there is a significant relationship between compatibility comprehension of cloud computing and the general adoption rate ($p = 0.004$ and $r = 0.37$). Which also means that those who are more compatible with cloud computing tend to have a higher acceptance rate in general.

Hypothesis (7): There is also a significant relationship between the lack of need for cloud computing and the adoption rate.

The obtained results from Pearson correlation coefficient in table (3) show that there is always a negative relationship between the lack of need for cloud computing and the adoption rate ($p < 0.001$ and $r = -0.69$). In other words, people who feel the need for cloud computing more, tend to have a higher adoption rate in comparison to those who do not.

Table 3 The correlations between Cloud Computing Acceptance Feature & Adoption Rate

Variables	Adoption rate	
	r	p
Testability Comprehension	0.63	<0.001
Comparative Advantage Comprehension	0.69	<0.001
Understanding the Visibility of Results (Observability)	0.55	<0.001
Examination Opportunities Comprehension	0.18	0.17
Complexities Comprehension	0.79	<0.001
Compatibility Comprehension	0.37	0.004
Understanding the Lack of Need for Cloud Computing	-0.69	<0.001
General Acceptance Features of Cloud Computing	0.71	<0.001

6. REGRESSION MODEL DETERMINANTS OF CLOUD COMPUTING ADOPTION RATE

Multiple regression analyses of data as well as the relationships amongst variables are both discussed in this part of the conducted research. Additionally, the objective of these analysis is to determine the precise contribution and effect major research variables (cloud computing adoption features) can have in the estimation of the dependent variable changes (adoption rate). In other words, multiple regression may very well help in the explain and prediction of the variance of the dependent variables of cloud computing adoption rate. In addition, this can only be done by estimating the degree of role and effect independent variable have in creating variance. Therefore, multiple regression can possibly be used in order to find out the existence as well as the precise degree of a relationship between a (Y) variable against any number of independent variables.

Therefore, in order to determine the precise degree of characteristics found between cloud computing acceptance and the adoption rate, multiple regression analysis is used along with a step-by-step method. Additionally, in the first step the complexities comprehension of cloud computing was used which resulted in a possible 62% estimation in the variance of cloud computing variables. Secondly, the testability comprehension variable is used in the equation, which may very well increase the estimations coefficient by 4% (from 62% to 66%). Furthermore, in the third step, the lack of need for cloud computing enters the equation and causes an increase in prediction coefficient by 3% (from 66% to 69%). In other words, the features and variables of complexity, testability comprehension as well as understanding the lack of need for cloud computing can together possibly explain 69% of the variance of the variable cloud computing adoption rate and hereby other variables were all removed from the equation due to the lack of significance. Moreover, amongst these three mentioned variables, the complexities comprehension perception feature with a coefficient of 0.49 has the greater part in the estimation of the variables of cloud computing adoption rate (Table 4 & 5).

Table 4 Multiple Regression Test Result Determinants of Cloud Computing Adoption Rate

Source of Changes		Squares Sums	Degree of Freedom	Squares Mean	F	Significance Degree	Correlation Coefficient	Determination Coefficient
Complexities Comprehension	Regression	3212.33	1	3212.33				
	Remaining Amount	1944.23	55	35.35	90.87	<0.001	0.79	0.62
	Total Sum	5156.56	56					
Testability Comprehension	Regression	3482.78	2	1741.39				
	Remaining Amount	1673.78	54	30.99	56.18	<0.001	0.82	0.66
	Total Sum	5156.56	56					
Understanding the Lack of Need for Cloud Computing	Regression	3663.71	3	1221.24				
	Remaining Amount	1492.85	53	28.17	43.36	<0.001	0.84	0.69
	Total Sum	5156.56	56					

Table 5 Beta Coefficient of Cloud Computing Adoption Rate for Regression Model Variables

Variables	Non-Standard Coefficient		Standard Coefficient	(T)Value	Significance Level
	The (B)Amount	Standard Error	(β)Value		
Fixed	26.75	11.37		2.35	0.02
Complexities Comprehension	2.04	0.45	0.49	4.58	<0.001
Testability Comprehension	0.69	0.26	0.24	2.69	0.01
Understanding the Lack of Need for Cloud Computing	-1.27	0.50	-0.25	2.53	0.01

Furthermore, structural equation model was also used in order to observe & analyze the possible effects of cloud computing adoption characteristics on the adoption rate. Additionally, the obtained results indicated that the precise amount of standard factor between the two variables of cloud computing acceptance characteristics and its adoption rate is about (0.95), in addition, since there is a significance relationship between the value of (T-statistics) and other previously mentioned variables (9.30), which is clearly more than the (1.96), therefore, it can be concluded that the adoption characteristics of cloud computing, do in fact have a positive and significant effect on the adoption rate.

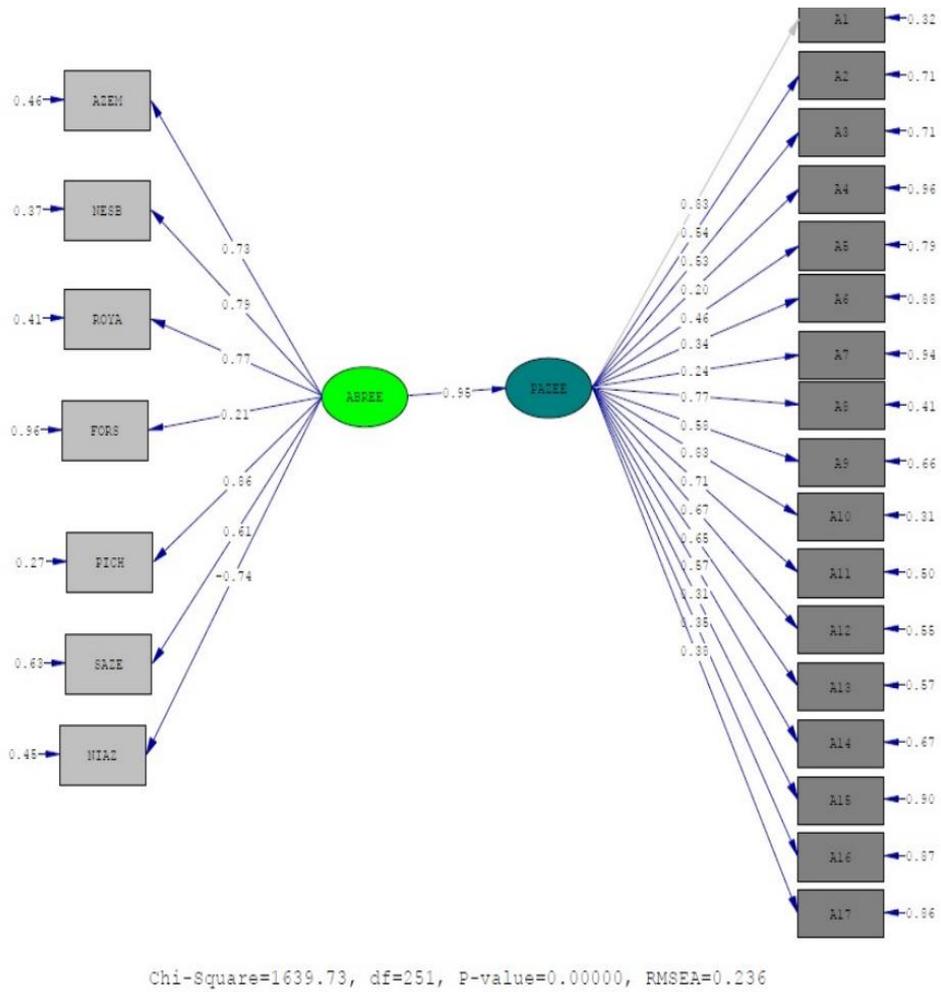
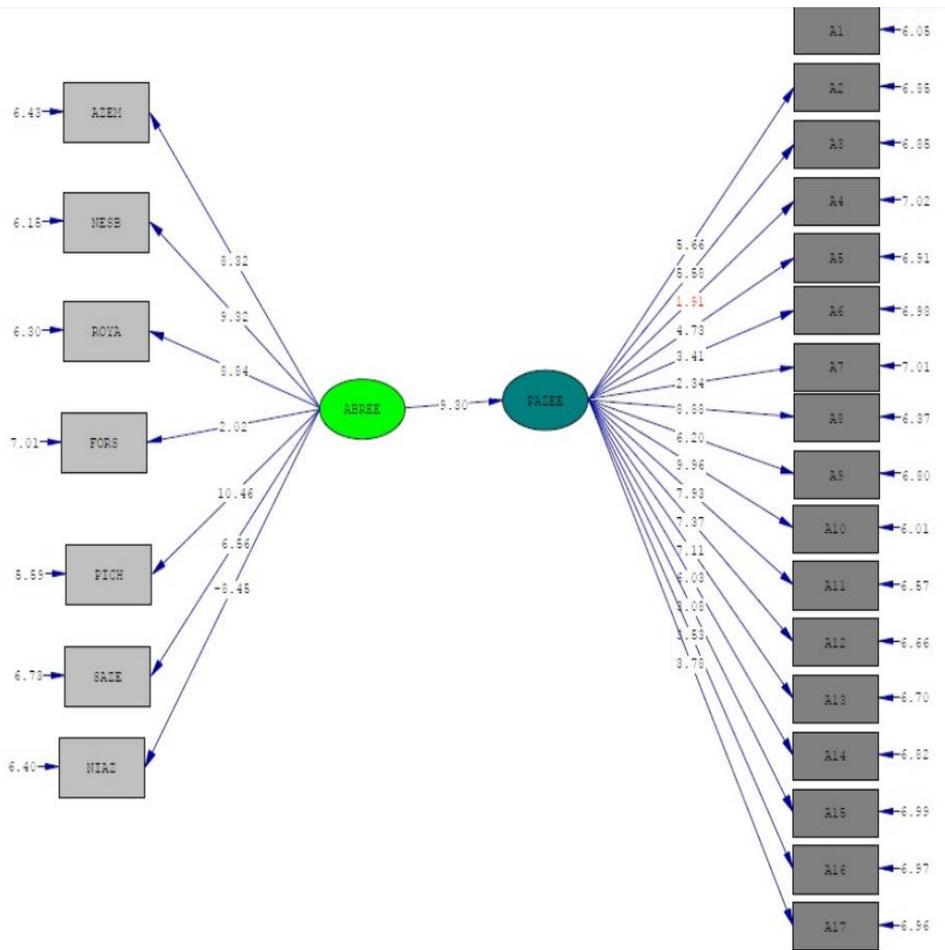


Fig. 1 The Standard Factors Related to the Effect on Cloud Computing Characteristics and its Adoption Rate



Chi-Square=1639.73, df=251, P-value=0.00000, RMSEA=0.236

Fig. 2 The value of T (t-statistics) is Significantly Related to the Effect of Cloud Computing and the Adoption Rate

7. DISCUSSIONS & CONCLUSIONS

The results of present paper conducted in an international airport (Birjand) indicated that there is meaningful and positive relationship between acceptance features of cloud computing and perception elements of testability, Comparative Advantages, The Visibility of the Results (Observability) and compatibility of cloud computing and its adoption rate, However, the relationship found between the lack of need for cloud computing and the adoption rate seems to be a negative kind of relationship which can also be significant simultaneously. On the other hand, there was no major relationship found between the feature of comprehension of examination opportunities of cloud computing and the adoption rate.

Farmanlu lilab et al. (2019) conducted a study on the librarians who worked at the Tabriz University of Medical Sciences and analyzed the factors that could potentially affect the adoption rate of cloud computing based on Roger's Diffusion of Innovation theory. Additionally, the most significant features of cloud computing which were identified using Heuristic Factor Analysis are as follows: Testability, Comparative Advantages, Complexity, Compatibility and the Observability of the obtained results. In addition to these five features, two other factors were also identified during this study which included test & examination opportunities as well as the lack of need for cloud computing. Furthermore, the obtained results of this particular study indicated that there is significant relationship among the characteristics and features of cloud computing such as testability, compatibility, complexity, comparative advantages, examination opportunities along with the lack of need for cloud computing and the adoption rate of cloud computing, however, there was no major relationship to be found between the observability of the results and cloud computing adoption rate in general. Moreover, we conclude that the results of this study, apparently is not consistent with the results obtained through the current conducted research (with the only exception being in the characteristics of examination opportunities and the observability of the results) [52]. Hamdipour & Zavaraqi (2018) conducted a research on the analyze of the factors that may potentially affect the acceptance of research information management system (SIMAP), using the personnel of Tabriz University. As a result, they came to conclusion that there is a significant relationship between the seriousness and determination of the university and the characteristics such as compatibility, testability, complexity and comparative advantages which very possibly may lead to a change in the speed of the adoption rate [53]. Nazari et al. (2012) in another study, examined the relationships between the complete comprehension of the characteristics mentioned in Roger's Diffusion of Innovation theory and the acceptance rate through the female personnel of District 8 of Islamic Azad University, as a result, they came to the conclusion that features such as compatibility, complexity, testability and observability, all have a positive impact on the relationship towards the acceptance rate [54]. The obtained results of the research conducted by Heidari et al. (2014) based on the Roger's Diffusion of Innovation theory, using the faculty members of Iranian Department of Information Science on the study of factors that could potentially affect the adoption rate of electronical information resources (such as cloud computing), indicates that the characteristics and features such as comparative advantage, testability, compatibility, complexity, observability and examination opportunities all have a significant impact on the speed or pace of the adoption rate of cloud computing or other available electronical information resources [35]. Furthermore, Ebadolahi et al. (2014) in another study conducted on the public libraries of the city of Tehran and its 22 different districts, examined and analyzed the possible effects of the five characteristics of innovation dissemination on the adoption rate. In conclusion, the results showed a significant as well as positive relationship between the various characteristics of technology (compatibility, testability, easy use, observability and comparative advantage) and the acceptance rate of journal index software used by librarians [27]. DO (2008) [55] in another research conducted on the faculty members and students of the College of Specialized Studies of Hawaii, examined the possible effects of the five characteristics of Roger's Diffusion of Innovation theory on the acceptance rate as well as the many uses in online educational admissions. Additionally, the obtained results show a significant relationship amongst the features of complexity, compatibility, observability, testability, comparative advantage and the acceptance rate of online educational technologies by the potential users. Al-Gahtani (2004) [56] in another study conducted on computing technologies and its

acceptance rate based on the Roger's Diffusion of Innovation came to the conclusion according to the obtained results that the two factors of testability and observability of the results can both have huge as well as positive impact on the acceptance rate of computers. Additionally, it is also important to know that the obtained results of this particular research seem to be consistent with our current study.

In order to describe the obtained results of the current study, it can be said that technologies or innovations that can potentially be tested in necessary cases or those that can be evaluated in either short or long-term, are more likely to be accepted by the social system as well as the community. Furthermore, those who have higher degree of comparative advantage comprehension also seem to have a much higher adoption rate, in addition, in order to explain this particular case, it can be claimed that components such as usefulness, various benefits, easy use, user-friendliness and task performances are all amongst the most important factors that may potentially have huge impacts on the adoption rate. Additionally, we also learn that individuals tend to have a higher adoption rate through better understanding the observability of the results. Therefore, it can be stated that if the results of using new technologies are constantly visible to the population, then they can witness the positive impacts of using it for themselves, and as a result the acceptance rates may increase. Moreover, the use of technology as an innovation is generally better accepted, if it is compatible with other factors such as social values, past experiences, job aspects and essential requirements. Finally, take note that those who are at more complex situations and feel the greater need for cloud computing, consequently tend to have a higher adoption rate. At the end, based on the obtained results of multivariate regression in the current study, we learn that among the various characteristics of cloud computing acceptance (understanding the lack of need for cloud computing as well as complexity and testability comprehension) are the most significant factors and predictors of cloud computing adoption rate overall, in addition, they make 69% of the variance of the cloud computing adoption variables. Additionally, amongst these three mentioned variables, the complexity comprehension with a beta coefficient of 0.49 seems to have the greater share of impact on the adoption rate of cloud computing in comparison with the rest of the variables. Moreover, the obtained results of the research conducted by Al-Gahtani (2004) [56] can indicate and confirm that technological complexity feature is the most effective factor found amongst the five technological characteristics which can ultimately determine the prevention or acceptance of computers and technological advancements.

Air transportation systems and airports have gradually adopted cloud computing as they worry about reliability, surveillance and security threats. But cloud computing is gradually changing the interaction of people with these systems. Acceptance of cloud computing provides different levels of decision making for air industry managers seeking prospects of applying cloud computing in their organization and it can affect decision making of air transport system managers. As using cloud computing service or the time of using the service requires costs, controlling it and lowering the prices is easier. When you choose cloud software, you control extra costs, and don't need to pay or the costs related to purchasing and maintaining servers and you only pay for user usage amount. Among air companies, small and medium ones don't have enough financial and human resources compared with large organizations so they can't efficiently update and upgrade their IT requirements. This causes that these organizations lose the chance of competing with their great rivals. Using cloud computing contributes these organizations to assess their organizational conditions for accepting services related to cloud computing. Using cloud computing in air transportation

systems and airports causes that these companies or a group of subsidiaries have better management strategies with lower costs as the cost is shared among the companies and the cloud computing can be profitable for these systems. Using cloud computing provides more storing space related to traditional methods of storing information as the storage is performed by cloud and cloud users can have access to the required knowledge in everywhere at any time using different systems like personal computers or smart tools like tablet, smart phones or mobile computers. Cloud computing causes flexibility and accessibility of IT through different resources and working with it is easier leads to smart and rapid survey of resources as the documents are not placed on personal computers and they are hosted on the cloud and multiple users can simultaneously work with the documents and projects and issues like customer relationship management, flexibility in organizational activities, ease of establishing new systems and business durability are important in using cloud. Scalability of cloud computing services leads to increasing and decreasing of resources for users in any time. Whenever due to high visit of website, so many resources are needed; cloud computing service automatically increases bandwidth so that there won't be any problem in processing. Using cloud computing systems decreases website, software and system downtime to great extent. Many cloud service providers present policies, technologies and controls that boost security condition of air transportation systems and support data, programs and organizational infrastructures against probable threats. Capability to backup and retrieve information by cloud computing system has turned it into one of the most reliable information processing and storing methods. Cloud computing systems are implemented in a big and secure datacenter and when update is provided, they are rapidly updated. This updating trend leads to high speed and high performance services at airports. Using cloud computing enables air transportation systems and airports to provide new services and technologies, identify their customer's needs and fulfill them.

Like any other study, the researcher has faced limitations due to the small sample size. If a larger sample size (for example the entire employees of airports in eastern Iran or total employees of Iranian airports) was available, more accurate results would be likely obtained. The results of the present study display the cloud computing acceptance at Birjand International Airport, thus, generalizing it to other airports should be carefully made with sufficient knowledge. Also, this study was conducted on personnel working in an international airport in eastern Iran, therefore it cannot be generalized to the entire community affiliated with the Iranian aviation industry. Another limitation of this study is the lack of similar research of cloud computing acceptance on airport personnel to compare the results.

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